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Research Product 84-23

HUMAN FACTORS, MANPOWER, PERSONNEL,
AND TRAINING REQUIRED OPERATIONAL
CAPABILITY (ROC) ENHANCEMENT

Systems Manning Technical Area
Systems Research Laboratory

December 1984

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EDGAR M. JOHNSON
Technical Director

L. NEALE COSBY
Colonel, IN
Commander

Technical review by

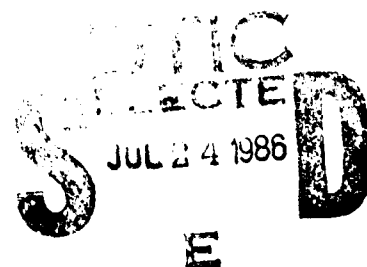
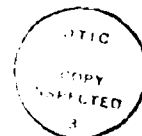
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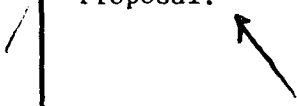
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Research Product 84-23

**HUMAN FACTORS, MANPOWER, PERSONNEL,
AND TRAINING REQUIRED OPERATIONAL
CAPABILITY (ROC) ENHANCEMENT**

David M. Promisel and John L. Miles, Jr.
Army Research Institute

W. P. Cherry
Vector Research, Inc.

Submitted by
John L. Miles, Jr., Acting Chief
Systems Manning Technical Area

Approved as technically adequate
and submitted for publication by
Jerrold M. Levine, Director
Systems Research Laboratory

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333

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ARI Research Reports and Technical Reports are intended for sponsors of R&D tasks and for other research and military agencies. Any findings ready for implementation at the time of publication are presented in the last part of the Brief. Upon completion of a major phase of the task, formal recommendations for official action normally are conveyed to appropriate military agencies by briefing or Disposition Form.

FOREWORD

The Army's weapon system acquisition process has been designed to include human factors, manpower, personnel, and training (HMPT) considerations in a comprehensive and timely fashion. However, this intent has not always been realized. Recently, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has been undertaking a series of special studies in response to a request by General Maxwell Thurman, now Vice Chief of Staff, who has been particularly concerned about HMPT issues in system design.

One study involved a "reverse engineering" analysis of the development of four specific systems to identify how and where to influence the acquisition process to achieve effective use of soldiers in weapon systems. A principal outcome was to confirm the need for the Army to prepare (1) system requirements documents that are more comprehensive with regard to HMPT objectives and constraints; and (2) system contractual documents that are more informative and explicit in terms of the role HMPT considerations must play in system design. This ARI Research Product is an outgrowth of these findings. It provides specific modifications to the format for the Required Operational Capability statement that now appears in AR 71-9 and the Materiel Acquisition Handbook, DARCOM/TRADOC Pamphlet 70-2. A companion ARI Research Product, No. RP 84-24, contains clauses for inclusion by the Army Materiel Command in requests for proposal for the concept exploration and demonstration and validation phases of the system development cycle.

ARI believes that these Research Products will be of immediate value to the Army. However, it is our intent to evaluate them through application to a sample of systems currently under development. The results of the evaluation will be incorporated in revisions to the documents.



EDGAR M. JOHNSON
Technical Director

HUMAN FACTORS, MANPOWER, PERSONNEL, AND TRAINING REQUIRED
OPERATIONAL CAPABILITY (ROC) ENHANCEMENT

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INTRODUCTION

As the Army modernizes with high-technology hardware, it must ensure that it can man new equipment. In the past, system performance requirements presented in requirements documents have not always been met by all soldiers operating, maintaining, and repairing the system in the field. There is good evidence that previously developed materiel systems have not performed in the field as desired because these systems were not designed with adequate consideration of the performance capabilities and limitations of the soldiers assigned to them.

The performance levels of hardware and software components of a system, in a given setting, are predictable with a relatively high degree of certainty. However, performance levels of soldier tasks or sets of tasks typically exhibit significant variation. Repeated trials by individual soldiers will result in a range of task performance levels for which mean values and variances can be determined; similar trials by different soldiers will lead to different mean values and variances. These differences are due to inherent differences in soldier aptitudes. Once a system design is fixed, it is the distribution of aptitudes translated through training into a distribution of task performance levels, that determine system performance, i.e., system performance levels can be expected to vary because of dependence on soldier task performance.

The requirements-driven acquisition process has as its goal the provision of a specified operational capability in the field subject to budgetary and schedule constraints or objectives. Implicit in this process is the fact that an operational capability derives from the engineering or technical parameters of a system, the role and performance of the soldiers that operate, maintain and repair the system, and the resources required to recruit, train, and maintain those soldiers over the life of the system. All of these factors must be considered in the materiel acquisition process, particularly when making estimates of required or achievable system performance to support design tradeoffs or program decisions.

Improvements to the Required Operational Capability (ROC) are described here to further the general goals of:

- o requiring performance not hardware
- o focusing on total system development

- o designing systems that consider explicitly the availability of people, skills and training resources
- o assessing system performance through comprehensive test and evaluation

The information constituting and supporting statements in the ROC evolves from preceding requirements documents and products of the Concept Exploration (CE) and Demonstration and Validation (D&V) phases of the acquisition cycle. Parallel modifications to those shown for the ROC have been developed for the CE and D&V RFP's (ARI, 1984).

The ROC formats specified in AR 71-9 (Dept. of the Army, 1984) and the Materiel Acquisition Handbook, DA PAM 70-2, (DARCOM/TRADOC, 1984) are essentially the same. The format appearing in the latter document has been chosen as the basis for presenting changes. In the following material the original text of the Handbook is shown in full: items recommended for deletion are stated with hyphens overstruck (as: ~~and-system-performance~~) and words and phrases to be added are underlined (as: and system performance). In addition, Annex F, Training Device Annex, is replaced in full by a new Annex F entitled Manpower, Personnel and Training Annex.

ROC FORMAT CHANGES

REQUIRED OPERATIONAL CAPABILITY (ROC) FORMAT

The Required Operational Capability (ROC) is in the format below. Limit information to that necessary for a HQDA decision. The basic document should not exceed four pages.

1. TITLE

- a. Give a descriptive title for the program.
- b. CARDS reference number.

2. NEED/THREAT. Briefly describe the operational/training deficiency need for the system and the reactive threat to the system. Include the enemy's capability to detect, identify, locate, avoid, suppress, destroy, or otherwise counter the system. Describe the responsive threat over time to support evolutionary development when applicable.

3. TIMEFRAME AND IOC. State the IOC date including IOCs for successive evolutionary models, when appropriate.

4. OPERATIONAL AND ORGANIZATIONAL PLAN (O&O Plan). In a brief paragraph state:

- a. How the equipment will be used;
- b. Geographical areas of use;
- c. Weather and climatological factors to be considered during equipment operations;
- d. Battlefield conditions (such as ECM, smoke, and dust) in which the system will operate; and
- e. The type of units that will use and support the equipment.

5. ESSENTIAL CHARACTERISTICS. Describe only main operational features of the system. Included are counter-countermeasure capabilities, health, safety and human factors engineering requirements, and reliability, availability, and maintainability (RAM). Performance must be responsive to battlefield environmental conditions of continuous combat (such as full ECM, smoke, aerosols, rain, fog, haze, and dust).

System performance requirements shall be stated in terms of desired distributions of performance in the field to reflect the range of characteristics of the pool of soldiers from which operators, maintainers and repairers must be drawn. Requirements should be expressed in this style:

REQUIRED OPERATIONAL CAPABILITY (ROC) FORMAT (continued)

For any system performance requirement, stated in terms of a given, fixed setting,

"- the level of performance, m_1 , must be achieved or exceeded at least x_1 percent of the time when system manning is drawn from the designated pool of soldiers..."

At least three sets of values should be stated for each system performance requirement representing:

- a minimum level of system performance to be achieved 95% of the time.
- a mean level of system performance;
- a superior level of system performance to be achieved at least 5% of the time.

Express performance and reliability characteristics in bands of performance. These which are not suitable for banding will be stated as single values. During development, commercial, other Service, NATO, or other allied nation characteristics of existing or programmed systems should be considered for inclusion with a view toward establishing a basis for interoperability, co-production, or standardization. Bands of Performance requirements should be flexible enough to consider competing systems of other Services or allied nations. Stated bands distributions of performance, or single value characteristics are adjusted only after the combat and materiel developers agree that changes are necessary. DCSOPS will approve changes for documents previously approved by DCSOPS. The requirements and provisions for the following must be considered:

- a. Interoperability;
- b. Continuity of Operations (CONOPS);
- c. Security;
- d. Reliability, availability, and maintainability (RAM) derived from mission performance parameters;
- e. Standardization, including commonality for hardware and software to which the system will adhere;
- f. Nuclear survivability; NBC contamination survivability;
- g. Individual/collective protection equipment;
- h. Adverse weather and reduced visibility (smoke and obscurants) operations, and military operations on urbanized terrain (MOUT) where applicable;

REQUIRED OPERATIONAL CAPABILITY (ROC) FORMAT
(continued)

- i. Communications;
- j. Operation transportability requirements, such as:
transportable in C-141 type aircraft requiring not more
than...hours teardown and...hours set up by operator and crew;
etc.
- k. P31

6. TECHNICAL ASSESSMENT. In the ROC, include a brief paragraph about the technical effort required. Address major areas for full scale development in terms of scope, technical approach, and associated risks in high, medium, low, or similar categories. Identify "high driver" tasks* where they either represent or are related to the major areas for development. Indicate the implications of the risks associated with full scale development for system performance and for manpower, personnel and training requirements. For NDI items, briefly outline completed or planned market survey efforts and/or military suitability evaluations.

7. LOGISTICS SUPPORT PLAN. Briefly describe the logistics support concept. The logistics support package will be tested during OT II.

8. TRAINING ASSESSMENT. Briefly describe the system training concept. Show its relationship to the elements of the O&O Plan. Summarize the manpower, personnel and training constraints presented in Annex F and their impact on system training. Discuss the need for system training devices. When required, include description of training devices as an annex to the ROC. New equipment training (NET) operator and maintenance personnel training, technical manuals and training materiel requirements will be stated in terms of needs for both institution and unit training levels. The training support package will be tested during OT II.

9. MANPOWER/FORCE STRUCTURE ASSESSMENT. Estimate manpower requirements per system, using unit, and total Army by component (Active, ARNG, USAR). Identify manpower savings resulting from replaced systems, if any. Include a statement to require an assessment of alternatives to reduce manpower requirements and an assessment of force structure implications resulting from system

* "High driver" tasks are those which are either critical (see para 6.2.1 of MIL-H-46855) to system performance and for which required task performance levels are believed difficult to achieve or for which required task performance frequency is uncertain and may have a major impact on manpower levels.

REQUIRED OPERATIONAL CAPABILITY (ROC) FORMAT
(continued)

inclusion in the total force by component. If the force structure assessment exceeds current programmed force structure levels then identification of force structure tradeoffs within mission area or mission elements is required. Tradeoff analyses are addressed to the degree necessary to bring the force structure assessment within current programming levels, if possible. The personnel support package will be tested during OT II.

10. STANDARDIZATION, INTEROPERABILITY . Discuss other Service, NATO, and other foreign interest in the program. Identify similar programs contemplated by other Services, NATO or other allies.

11. LIFE CYCLE COST ASSESSMENT. See appendix 1.

12. MILESTONE SCHEDULE. A listing of significant events with dates to occur between approval of the ROC and next scheduled milestone review. The following should be included: ROC approval, DT/OT/other test (Market/User Survey for OTS), and next scheduled milestone review.

APPENDIX 1 - Life-cycle Cost Assessment. Provide life-cycle costs using mainly summary parametric estimating techniques. State the major life cycle phases of R&D, investment, and operation and support. Also include the design-to-cost goals. As much as possible, show the estimated cost of major items or components below the system level. (These data should be consistent with the Materiel System Requirements Specification (MSRS) and Baseline Cost Estimate (BCE). (See app D, p. D.7, this handbook, for format).

ANNEX A - Coordination. List all major commands, other Services, allied nations and activities with whom the ROC was coordinated. Provide full rationale for nonacceptance of comments, if any.

ANNEX B - Operational Mode Summary/Mission Profile Annex. List tasks and conditions for frequency and urgency viewed for system employment in military operations. The mission profile is logically derived from the operational/training concept. It provides the starting point for developing the system characteristics.

ANNEX C - COEA Annex. Executive summary of the COEA. Classify as required. Withdraw after HQ TRADOC approval of the ROC and handle as a separate document for transmittal as needed.

ANNEX D - Rationale Annex. Support various characteristics stated in the ROC. This provides an audit trail and rationale for determining how the characteristics were derived.

REQUIRED OPERATIONAL CAPABILITY (ROC) FORMAT
(continued)

ANNEX E - RAM Rationale Annex. Executive summary of the RAM Rationale Report. Support the stated RAM characteristics with a logical argument that begins with the task frequency, conditions, and standards described and analyzed in the Mission Area Analysis (MAA). This provides an audit trail and rationale for determining how the characteristics were derived. TRADOC/DARCOM Pamphlet 70-11 contains guidance on the preparation of both the RAM Rationale Report and the RAM Rationale Annex.

ANNEX F - MANPOWER, PERSONNEL AND TRAINING ANNEX. Summary of current status of manpower, personnel and training (MPT) constraints and decisions; statement of major MPT issues to be addressed during full-scale development. The following format is provided for guidance: (Note: This replaces the current ANNEX F - TRAINING DEVICE ANNEX)

FORMAT OF MPT ANNEX

1. Introduction
2. Restatement of MPT Constraints for Materiel Developer
 - a. Description of Aptitudes of Intended Operators, Maintainers & Repairers
 - b. Limit on Institutional Training Time
 - c. Limit on Institutional Training Cost
3. Summary of relationship of soldier performance to measures of system effectiveness
4. Manpower
 - a. Confidence levels regarding manpower estimates
 - b. Identification of any tasks without associated manpower estimates
5. Remaining Personnel Risks
 - a. Tasks yet to be analyzed to determine personnel skill requirements
 - b. MOS decisions still to be made

REQUIRED OPERATIONAL CAPABILITY (ROC) FORMAT (continued)

6. Training

a. Description of alternative training programs resulting from CTEA

b. Identification of decisions yet to be made

c. Identification of remaining critical issues

d. Training Devices Needed (brief description of each device covering)

(1) What skill is to be imparted to personnel of what aptitudes?

(2) What frequency of use is expected?

(3) Plans for simultaneous or contemporary fielding of device with system

(4) Principal (Essential) characteristics of device

(5) Summary of analysis of logistical supportability

(6) Funding

7. Test and Evaluation

a. What data will be needed when to verify that soldiers of the specified aptitudes will be able to perform to the required standards with the training program designed by the contractor?

b. Identification of responsibility for the collection and analysis of MPT data

NOTES: 1. Send annex A with each requirements document.

2. Annex F (when prepared) must accompany the ROC to HQDA for approval as a package.

3. Send the TBOIP/TQQPRI with the ROC to HQDA for approval. When the TBOIP/TQQPRI are not submitted, the transmittal letter will contain a statement about the projected submission date.

REFERENCES

Department of the Army, Headquarters. Force Development Materiel Objectives and Requirements. Army Regulation 71-9, August 15, 1984.

U.S. Army DARCOM and TRADOC, Headquarters. Materiel Acquisition Handbook, DARCOM and TRADOC, 1984. Pamphlet 70-2, January 29, 1984.

U.S. Army Research Institute. Human Factors, Manpower, Personnel and Training Clauses for the Concept Exploration and the Demonstration and Validation Requests for Proposal. Research Product, In Press.